

Laser Underwater Cleaning of Hulls of Sea Vessels

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The natural phenomenon of biological fouling of the surfaces of ship hulls in the tropical waters of the World Ocean occurs rather quickly and has a negative effect on the hydrodynamic parameters. Considering its scale, huge resources are spent annually in the world to combat the problem of marine fouling [1].

Analysis of existing research on issues related to the search for optimal technical solutions for the operational and environmentally safe underwater cleaning of marine vessels from fouling showed that currently there are no industrial technologies and devices that allow fast, accurate restoration of the hydrodynamics of the hulls of ocean-going ships [1,2].

In Institute of Automation and Control Processes (IACP) FEB RAS it was proposed to use laser energy to clean ship hulls from biological fouling directly in the marine environment without docking [3].

The results of the research carried out on the processes of interaction of laser radiation with biofouling and anti-fouling coatings of the underwater part of the surface of the hulls of sea-going ships showed that the most effective spectral range for ablative cleaning of the surface of ships from biofouling is 1100 - 1500 nm.

This makes it possible to use a compact and energy-efficient technological fiber laser as part of robotic underwater complexes [4].

During the development of the "Device for laser underwater cleaning of the surface of objects from biofouling", special attention was paid to the search for technological solutions in which a focused laser beam, being in an underwater air-gas bubble, removes material objects of biological origin at a depth of 20 meters.

The optical scanning system is equipped with a "flat slit nozzle" that protects the laser beam and optical components from water due to the formation of a gas bubble.

In fig. 1 shows the appearance of the manufactured arrangement of a flat slit nozzle installed on the 2D-scanning system "IPGP Mid-Power Scanner".

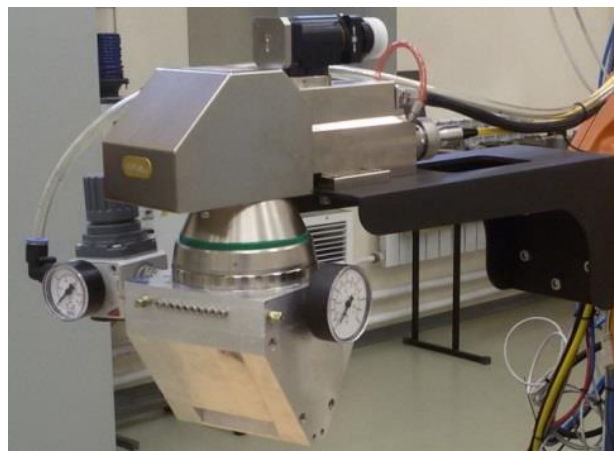


Fig. 1. External view of the manufactured model of a flat slit nozzle connected to the 2D-scanning system "IPGP Mid-Power Scanner"

"Device for laser underwater cleaning of the surface of objects from biofouling" is equipped with a robot-carrier of the laser optical scanning system (Fig. 2).



Fig. 2. External view of the manufactured "Model of the device for laser underwater cleaning of the surface of objects from biofouling"

An analysis of the results of preliminary studies showed that with an appropriate choice of the spectrum and power of laser radiation, the ship's hull can be cleaned without damaging the paint, and the cleaning speed is at least $15 \text{ m}^2 / \text{h}$, with an average cost of $\$ 0.25 / \text{m}^2$.

References

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